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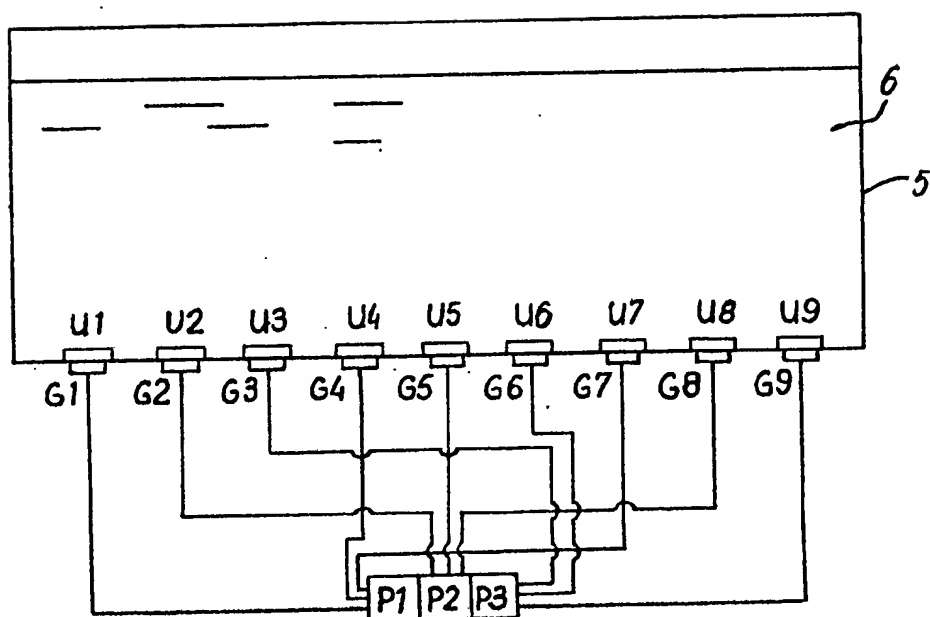
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(54) Ultrasonic cleaning

**(57) A method of and apparatus for
ultrasonic cleaning comprises**

introducing into an ultrasonic cleaning
vessel at least three ultrasonic power
pulses derived from the separate
phases of a three phase AC supply.

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SPECIFICATION

Ultrasonic cleaning

The invention relates to methods and apparatus for ultrasonic cleaning.

- 5 Previously proposed ultrasonic cleaning apparatus utilises conventional single phase AC mains voltage supply at 50 or 60Hz to operate a voltage generator which in turn energises a transducer producing vibration at ultrasonic
- 10 frequencies of around 40KHz. Generally a number of transducers are connected to a cleaning tank or like vessel and transmit the ultrasonic vibrations to liquid in the cleaning tank in which articles to be cleaned are immersed. Hitherto the AC mains
- 15 supply has generally been rectified resulting in pulses of ultrasonic oscillations at either twice the mains frequency or at mains frequency according to whether the rectification is full wave or half wave. Half wave rectification is useful in some
- 20 applications because of the pause between pulses but use of full wave rectification results in twice the power generation compared with half wave rectification.

- It is an object of the present invention to
- 25 provide an improved means of generating ultrasonic power pulses whereby to produce an improved cleaning action in ultrasonic cleaning apparatus.

- The invention provides a method of ultrasonic
- 30 cleaning comprising introducing into an ultrasonic cleaning vessel at least three ultrasonic power pulses derived from the separate phases of a three phase AC supply.

- The separate phases of the three phase supply
- 35 may be half or full wave rectified and may be applied in any desired order to individual ultrasonic generating means coupled to respective ultrasonic transducers.

- The invention also provides ultrasonic cleaning
- 40 apparatus comprising a vessel adapted to contain cleaning liquid, at least three ultrasonic transducers associated with the vessel to impart ultrasonic pulses to liquid contained therein and means for connecting the respective transducers
- 45 to the separate phases of a three phase AC voltage supply. Preferably each transducer is supplied from an associated voltage generator supplied from one phase of the three phase supply.

- 50 Where three ultrasonic generators are provided the separate phases of the AC voltage supply may be connected one to each generator in any desired manner. Advantageously however for larger installations ultrasonic generators and associated
- 55 transducers are provided in multiples of three; in this event successive generators are preferably supplied by different phases of the three phase supply.

- An embodiment of the invention will now be
- 60 described, by way of example only, with reference to the accompanying diagrammatic drawing which shows one form of ultrasonic cleaning apparatus according to the invention. The apparatus comprises a tank 5 adapted to contain a

- 65 cleaning liquid 6 in which articles to be cleaned are immersed. Attached to the underside of the tank are nine ultrasonic equispaced ultrasonic transducers U1—U9 each having an associated voltage generating device G1—G9 respectively.

- 70 The generating devices G1, G4 and G7 are connected to one phase P1 of a 50Hz AC mains supply and generate voltage signals at ultrasonic frequencies of around 40KHz. Generators G2, G5 and G8 are connected to the second phase P2 of
- 75 the three phase supply and generators G3, G6 and G9 to the third phase P3. The three phases are full wave rectified whereby to provide three sets of power pulses at mains frequency derived from the respective phases of the supply.

- 80 Because of the disposition of the transducers in the tank a pulse derived from each phase of the mains supply is imparted to the cleaning liquid at each end and in the central region of the tank at all times. Ultrasonic waves propagated in cleaning
- 85 tanks of this kind do not produce substantial cleaning effect more than about 24 inches from the transducer. By connecting the transducers in the manner described, three effective cleaning pulses are transmitted to each region of the tank
- 90 during each cycle of the three phase supply and at least one pulse producing cleaning action is effective in each region of the tank at all times.

- If the transducers U1 to U3 were connected to one phase of the supply, the transducers U4 to U6
- 95 to the second phase and transducers U7 to U9 to the third phase, the cleaning action would tend to progress through the tank from one end to the other which might be suitable in certain circumstances but in general would not be
- 100 desirable. It is preferred therefore to inter-connect the transducers in the manner described so that successive transducers are fed from a different phase of the three phase supply, although in small tanks where the distance from one end to the
- 105 other is less than 24 inches the transducers may be connected to the three phase supply in any order. The manner of connection does not alter the average power imparted to the cleaning fluid as a whole but the peak power and the time
- 110 distribution of the power pulses throughout the tank will vary dependent on the connection arrangement.

- Various modifications may be made without departing from the invention. For example the
- 115 frequency of the AC supply voltage and of the ultrasonic voltage generated may be varied as desired and while it is preferred to connect successive transducers to different phases of the three phase supply, alternative methods of
- 120 connection may be utilised if desired and may be advantageous in certain circumstances. Variations may also be desirable dependent on the positioning of the transducers on the cleaning vessel. While in the arrangement described an
- 125 ultrasonic voltage generator is provided for each transducer, a plurality of transducers could be supplied from a single generator, there being at least three such generators supplied from the respective phases of the three phase supply.

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Whilst endeavouring in the foregoing specification to draw attention to those features of the invention believed to be of particular importance it should be understood that the applicant claims protection in respect of any patentable feature or combination of features hereinbefore referred to whether or not particular emphasis has been placed thereon.

CLAIMS

- 10 1. A method of ultrasonic cleaning comprising introducing into an ultrasonic cleaning vessel at least three ultrasonic power pulses derived from the separate phases of a three phase AC supply.
- 15 2. A method as claimed in claim 1, in which the separate phases of the three phase supply are halfwave rectified.
3. A method as claimed in claim 1, in which the separate phase of the three phase supply are full wave rectified.
- 20 4. A method as claimed in any one of claims 1 to 3, in which the separate phases of the three phase supply are applied in any desired order to individual ultrasonic generating means coupled to respective ultrasonic transducers.
- 25 5. Ultrasonic cleaning apparatus comprising a vessel adapted to contain cleaning liquid, at least three ultrasonic transducers associated with the vessel to impart ultrasonic pulses to liquid contained therein and means for connecting the respective transducers to the separate phases of a three phase AC voltage supply.
- 30 6. Ultrasonic cleaning apparatus as claimed in claim 5, in which each transducer is supplied from an associated voltage generator supplied from one phase of the three phase supply.
- 35 7. Ultrasonic cleaning apparatus as claimed in claim 5 or claim 6, in which where three ultrasonic generators are provided, the separate phases of the AC voltage supply are connected one to each generator in any desired manner.
- 40 8. Ultrasonic cleaning apparatus as claimed in claim 5 or claim 6, in which the ultrasonic generators and associated transducers are provided in multiples of three.
- 45 9. Ultrasonic cleaning apparatus as claimed in claim 8, in which successive generators are supplied by different phases of the three phase supply.
- 50 10. A method of ultrasonic cleaning substantially as hereinbefore described with reference to the accompanying drawing.
11. Ultrasonic cleaning apparatus substantially as hereinbefore described with reference to the accompanying drawing.